Module 8:
Risk Assessment

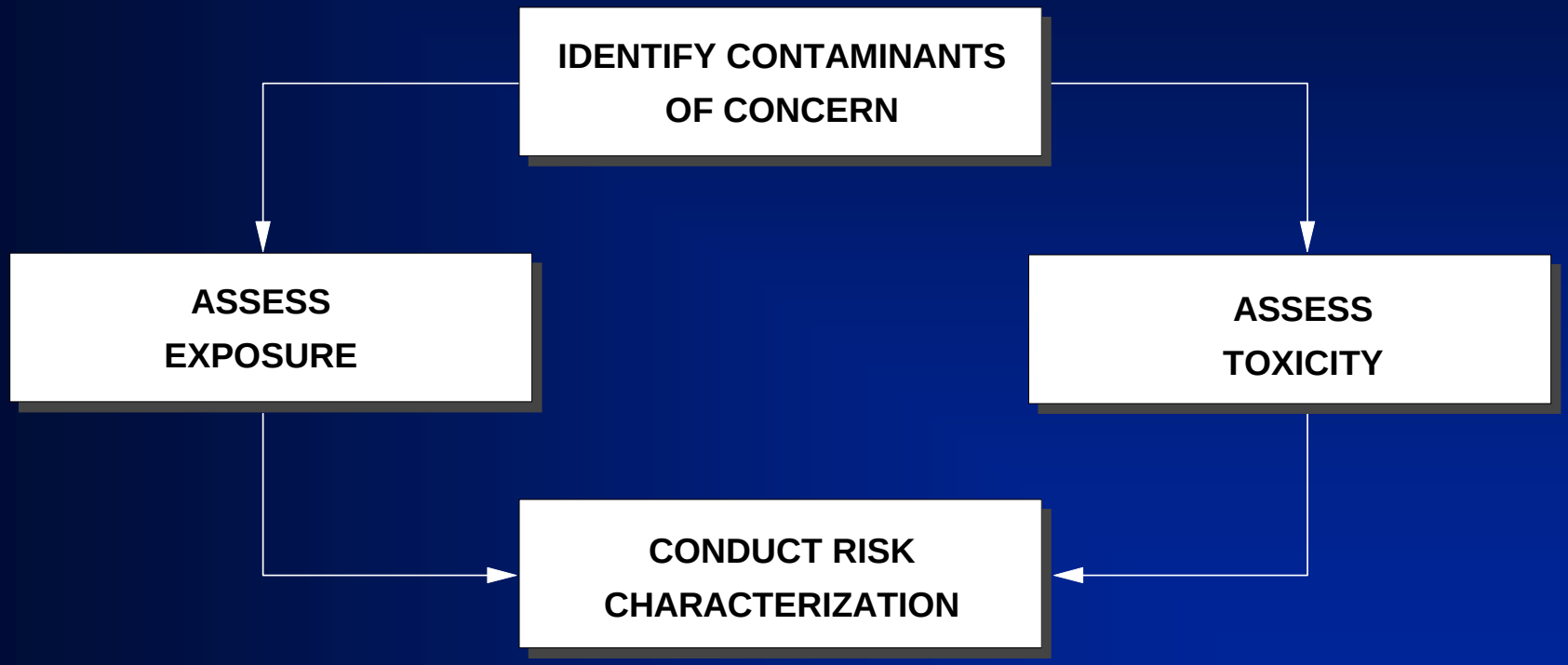
Module Objectives

- Define the purpose of Superfund risk assessment
- Define the four components of the human health risk assessment process
- List how radiological risks are included in the risk assessment process
- Explain how radiological risk assessment differs from chemical contaminant risk assessment

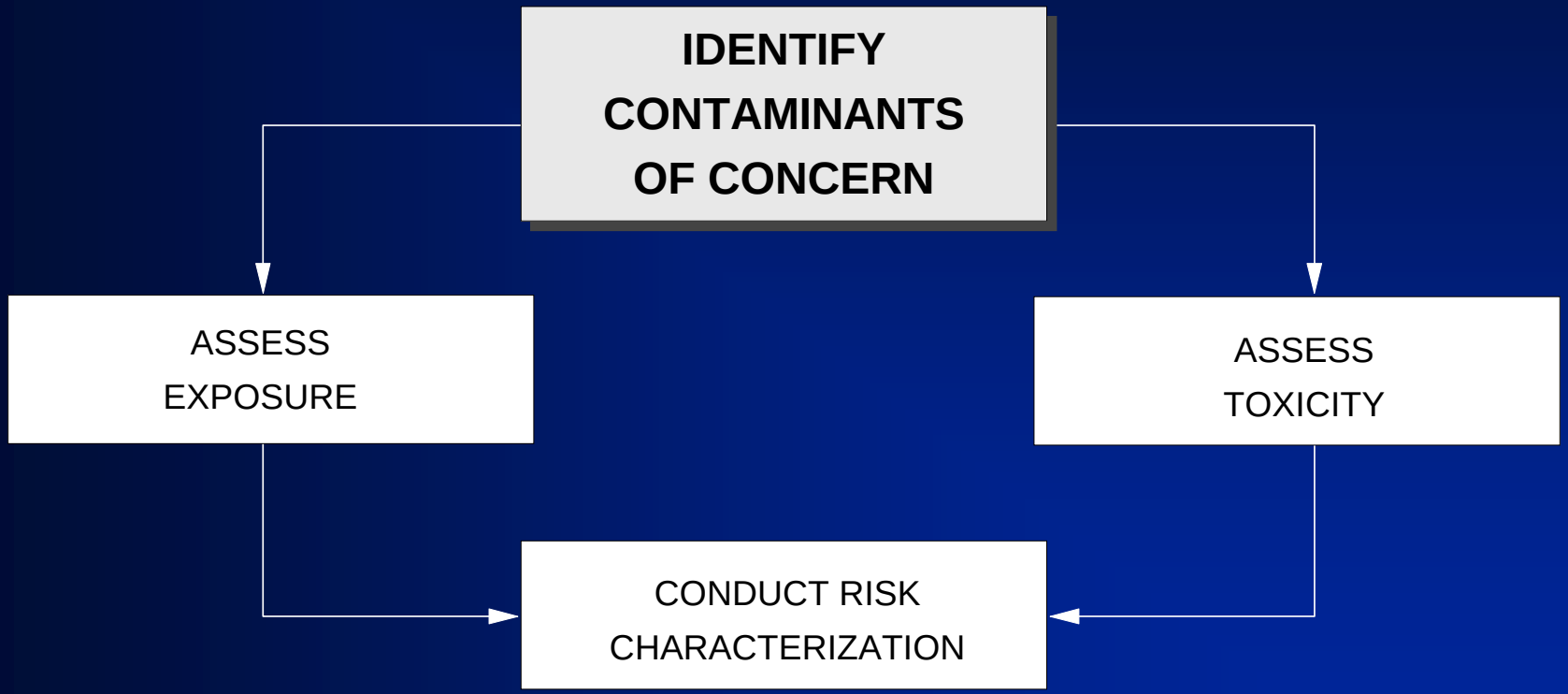
Risk Assessment in Superfund

- Consistent framework for developing risk information necessary to assist decision-making
- Purpose of risk assessment
  - Determine whether remedial action is necessary
  - Help provide justification for performing remedial action
  - Assist in determining what exposure pathways need to be addressed by remedial action
  - Addresses both human and ecological risks (separately)
- DOE sites likely to have a lot of data and risk assessment tools available
- Involve risk assessors early in project

Risk Assessment in Superfund



The Baseline Risk Assessment: Identifying Contaminants



The Baseline Risk Assessment: Identifying Contaminants

LAB REPORT

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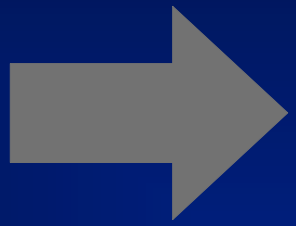


CHEMICALS OF CONCERN

CCl_4

As, Pb, Cr

TCE, TCA, DCE

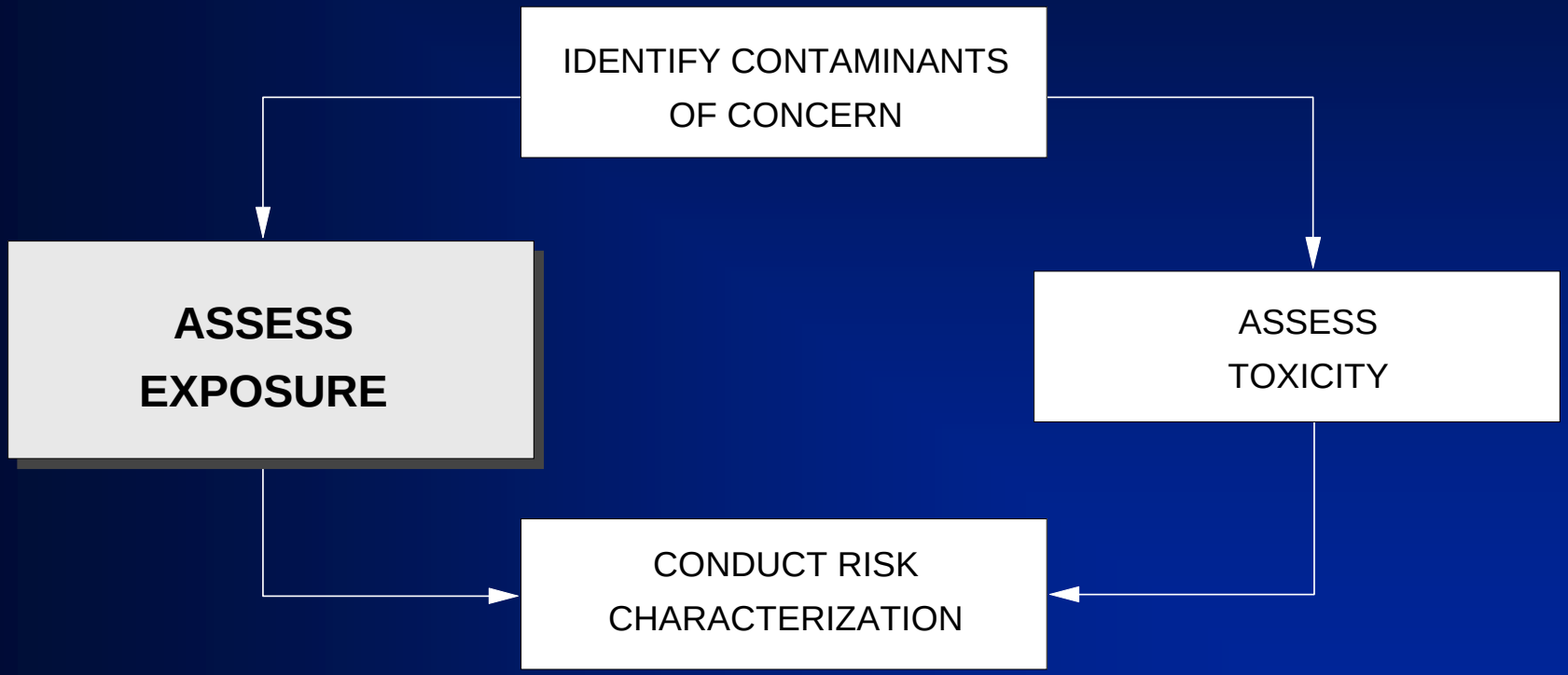
PCB

ORGANICS

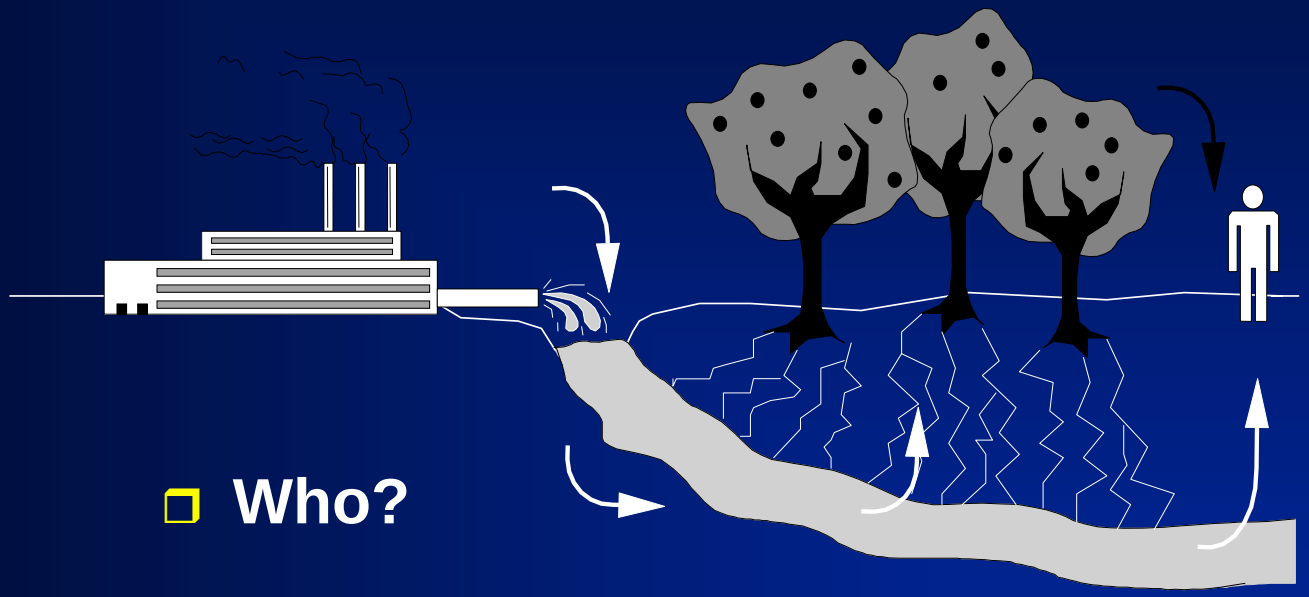
INORGANICS

- **Most Toxic**
- **Most Mobile**
- **Most Persistent**

The Baseline Risk Assessment: Assessing Exposure



The Baseline Risk Assessment: Assessing Exposure

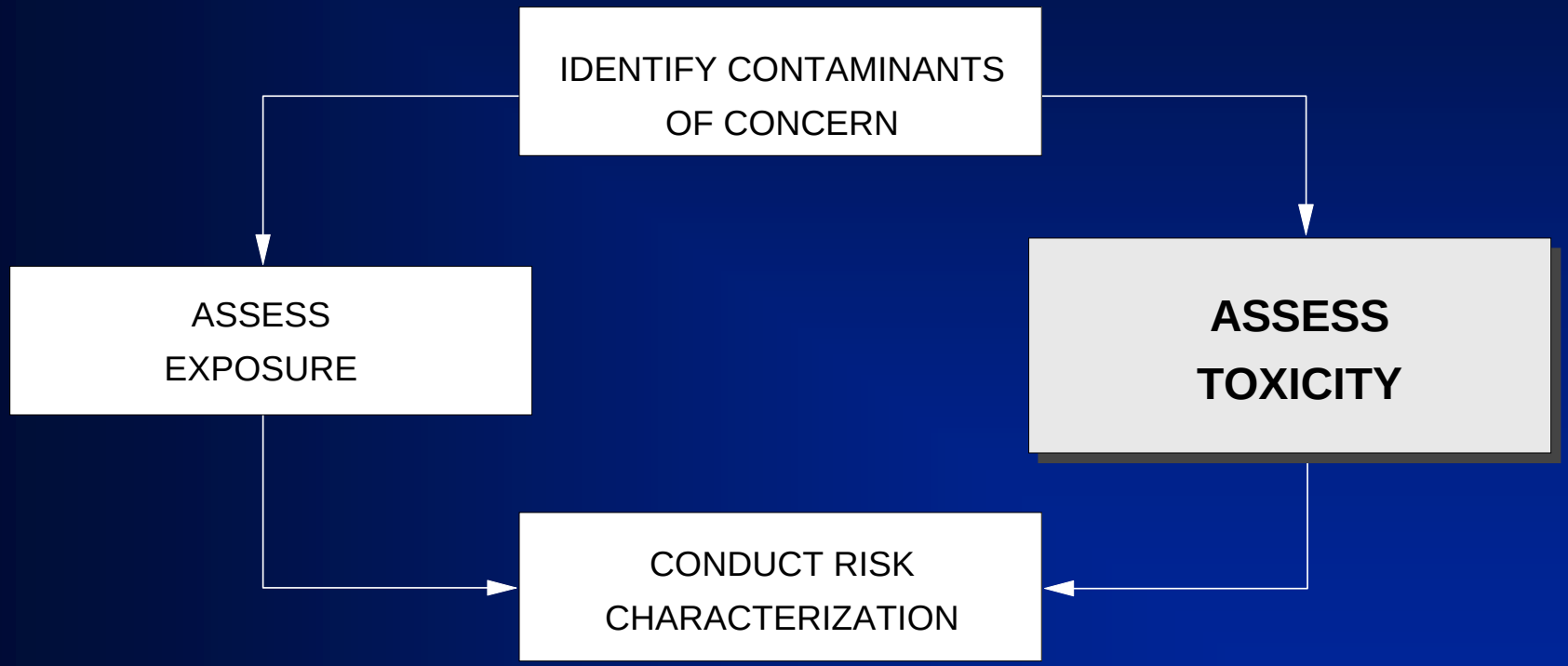


- Who?
- Where?
- How Much?

Estimate Expected Exposure Levels

- Reasonable maximum exposure (RME) scenario
- Use standard exposure assumptions
- Collect information on frequency and magnitude of exposure

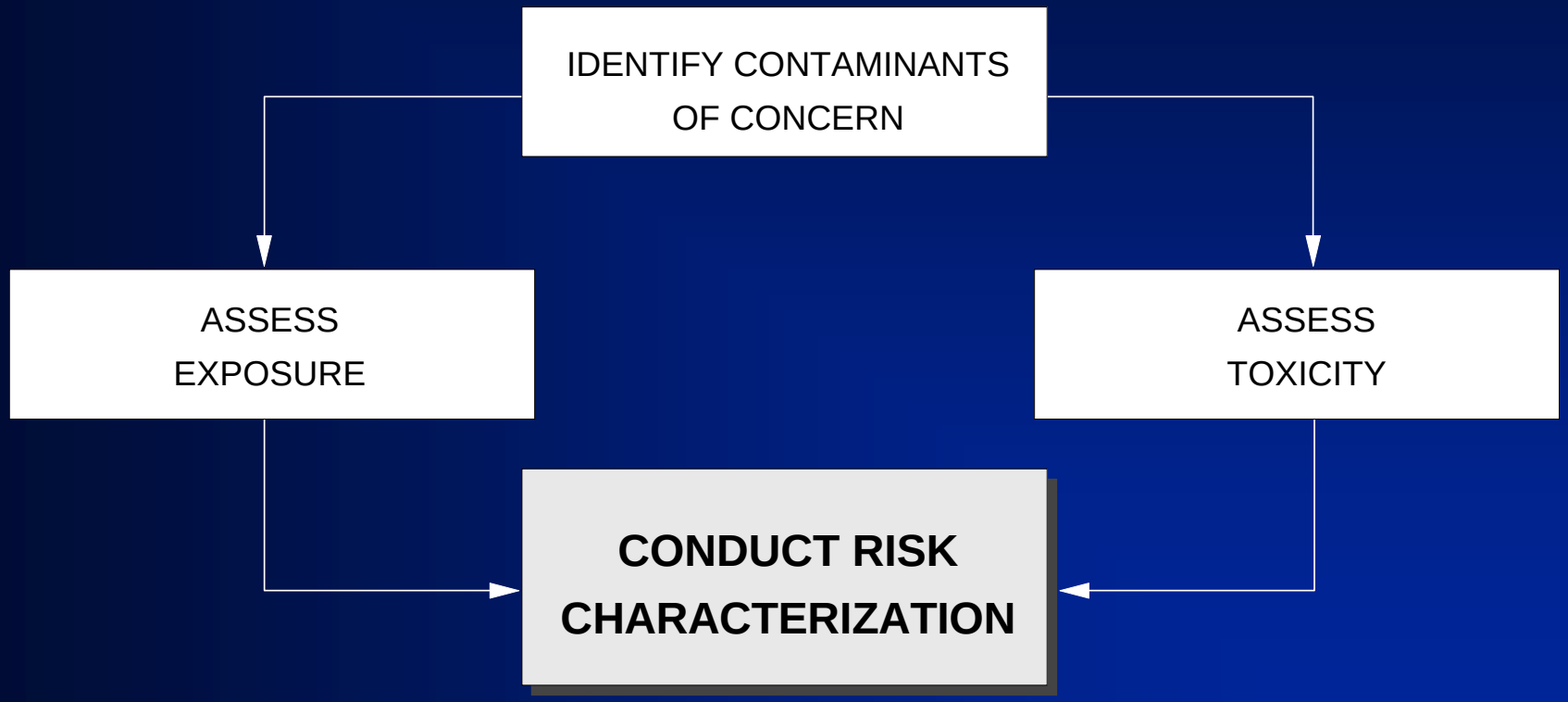
The Baseline Risk Assessment: Assessing Toxicity



Toxicity Assessment

- Toxicity values generally are based on previously developed EPA data
- Types of adverse health or environmental effects associated with individual/multiple exposures
- Relationship between magnitude of exposures and adverse effects
- Related uncertainties

The Baseline Risk Assessment: Characterizing Risk



Risk Characterization

- Should summarize:
  - Contaminants of concern
  - Exposure evaluation
  - Weight of evidence (especially for toxicity information)
  - Risks associated with each potential route of exposure and contaminant of concern at the site
- Should discuss any major uncertainties in assumptions or expectations

Risk Communication

- Explaining magnitudes - drop in swimming pool = mg/l
- Comparing risks
- Explaining risk versus hazard
- Describing risk perception

Superfund Radiological Risk Assessment Approach and Issues

Basic Superfund Concepts

- Radiological risk assessment is conducted separate from (in addition to) chemical risk assessment
- Usually, results are not combined, but are considered jointly when using risk assessment results
- There may be differences in risk analyses because of the way radiological substances affect the body
- Assessing radioactive risks requires the expertise of an experienced health physicist

Identification of Exposure Scenarios

- Exposure scenarios describe the components for potential human exposure pathways
- Radiation exposure may be internal or external
- "Effective dose equivalent" and "committed dose equivalent" are used in describing exposure scenarios
- Superfund requires identification of both current and future reasonable maximum exposure scenarios for each site
- Therefore, Superfund assessment must identify potential for occupational exposure (short-term risk) and general population exposure (long-term risk)

Selection of Contaminants of Potential Concern

- Usually, a very limited number of radionuclides at a site contribute significantly to the human health risk
- The DOE manager should consult with an experienced health physicist to develop a conceptual model of the facility, and to identify the anticipated critical radionuclides and pathways

Exposure Assessment

- Virtually identical for radioactively contaminated sites and for chemically contaminated sites
- Sites with radionuclide contamination should conduct a survey to determine external radiation levels
- For chemical exposure, units are mg/kg-day. Radionuclide exposure is typically expressed in units of activity (i.e., Curie) rather than mass
- Like chemicals, a radionuclide's transfer rate into the environment must be examined
- Biological and chemical transformation can never alter the radioactivity of a radionuclide, whereas chemical contamination may be dramatically affected by these processes

Toxicity Assessment

- Toxicity assessments for radionuclide exposure are better understood than toxicity assessments for chemical exposure
- Dose-response assessments for radionuclides are better characterized
- For both radionuclides and chemicals, cancer toxicity values are obtained by extrapolation from experimental and epidemiological data
  - For radionuclides, however, human epidemiological data form the basis for the extrapolation
  - For chemical carcinogens, laboratory experiments are generally the basis for the extrapolation

Toxicity Assessment (cont'd)

- Radiological human data leads to greater confidence in extrapolating risk of low doses of radiation than in extrapolating from laboratory animal experiments for chemicals

Risk Characterization

- Risk characterization for radionuclides is better understood than risk characterization for chemicals
- The DOE manager integrates (but does not necessarily combine) radiological and chemical risk information to reach a management decision
- In some cases, radiological and chemical risk assessments may be summed to determine the overall potential human health hazard associated with a site. Much caution is needed before summing these risks, however

Uncertainty

- Uncertainty is associated with all steps of the risk assessment process
- The DOE manager must evaluate and discuss the uncertainties of each step of the risk assessment
- Some steps of radiological risk assessments have significantly less uncertainty associated with them than those steps of chemical risk assessments
- The appropriate way to characterize an uncertainty will depend on the needs of the analysis and other factors

Module Summary

- The purpose of the Risk Assessment is to:
  - determine whether remedial action is necessary
  - help provide justification for performing remedial action
  - assist in determining what exposure pathways need to be addressed by remedial actions
  - address both human and ecological risks
- Components of human health risk assessment in superfund includes identifying contaminants of concern, assessing exposure and toxicity, and conducting risk characterization
- Radiological and chemical risk assessments are conducted as separate assessments. However, the results of these assessments are not combined, but are considered jointly for a more thorough assessment